SOME CONCEPTS AND ECONOMETRIC MODES OF MACROECONOMIC PERFORMANCE ANALYSIS

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Abstract

For the analysis of the macroeconomic performances, a system of correlated indicators is used, which after the interpretation gives the meaning of the future evolution of the economy. As a rule, macroeconomic models are used which, implemented, ensure the obtaining of parameters on which the macroeconomic evolution perspective can be predicted. One starting point in defining the concept of a macroeconomic model is the idea of a general stochastic process that generated the observed data. Practically, these particularities are easy to detail. Thus models for consumption and investment analysis or models based on statistical theory can be constructed, such as the autoregressive model with reduced dimensional vector. In constructing a macroeconomic model, a procedure can be followed that includes: definition and analysis of economic subsectors for the choice of variables; building the relevant partial models and then combining these sub-models in order to obtain a model representation of the whole economy. In practice, we must proceed gradually to include all elements of the considered submodels. Macroeconomic models have been dealt with by a number of researchers, a context in which theories are analyzed in the paper.

Keywords: *indicator, econometric model, variables, macroeconomic performance, analysis*

JEL Classification: C10, C82, E70

Introduction

The authors conducted an extensive study on the concepts underlying the construction of macroeconomic performance analysis models taking into account the evolution of these concepts in time. Developments in this area are expressed, summarizing a series of issues that then formed the basis for building models for macroeconomic analysis. The article states that a concept of macroeconomic modeling is based on the hypothesis that if model A is a part of model B, it is possible to identify data for model B in model A. Are points of view of the classics of modeling theory outlining the elements of which must be taken into account in the modeling process for macroeconomic analysis. One by one, the main aspects of Jan Timbergen's models are then presented to the Haavelmo model or more recently the econometric elements on which macroeconomic models are based. The article provides a broad overview of the concepts underlying the construction of macroeconomic analysis models.

Literature review

Anghelache, Anghel, and Marinescu (2019) analyzed a series of elements related to national wealth indicators that have implications for macroeconomic performance. Anghelache and Anghel (2018) presented the main econometric methods and models used in macroeconomic analyzes. Anghelache, Anghel, and Dumitru (2018) highlighted how macroeconomic performance indicators were calculated. Anghelache, Isaic-Maniu, Mitruţ, Voineagu and Dumbravă (2007) highlighted the main theoretical and practical aspects of the macroeconomic analysis. Bardsen, Nymagen and Jansen (2005) studied the use of econometrics in macroeconomic modeling. Benjamin, Herrard, Hanee-Bigot and Tavere (2010) studied the use of econometric models in macroeconomic forecasts. Carrasco, Florens and Renault (2004) studied inverse linear problems in structural econometrics. Dougherty (2008) presented the basic notions of econometrics. Fernandez-Villaverde and Rubio-Ramirez (2009) studied key aspects of macroeconomics. Johansen and Nielsen (2010) analyzed the probability of inference for an autoregressive model.

Research methodology, data, results and discussions

Macroeconomic modeling aims to highlight the empirical behavior of a real economic system. Such models are designed as interconnected equations based on dynamic series using statistical or econometric techniques.

A conceptual starting point is the idea of a general stochastic process that generated the observed data on the economy, and that this process can be summed up in terms of distribution with multiple probability variables of the randomly observable variables in a system of stochastic equations. However, it is possible to make an aggregate approach to represent the behavior of important variables (eg inflation rate, GDP growth, unemployment rate) in a model. Estimation of such econometric models can be based on statistical theory (autoregressive models with low VAR dimensional vector).

Practically, it is easy for the user to detail the particularities of the model (separate modeling of consumption and investment) to simulate all the equations simultaneously. The models that are used to analyze the impact of the government budget on the economy are large systems of equations. Even if the model uses only a variable from the outgoers, such as the inflation target, policy choices are made against the background of a wider analysis of the effects of the interest rate on the economy (nominal and real exchange rates, financial stability). Model makers have the task of establishing good practice and developing operational procedures to build models that ensure that the end result of modeling is solid and useful. Major contributions to literature on macroeconomic models include the works of Christ (1966), Klein (1983), Fair (1984, 1994), Klein (1999), or the research by Bodkin (1991) and Wallis (1994).

In constructing a macroeconomic model we suggest the following operational procedure:

- defining and analyzing the sub-sectors of the economy through relevant variables;
- constructing (by conditioning) relevant partial models that we can call Type A models by considering exogenous and endogenous variables;
- combining these sub-models in order to achieve a B-Model of the entire economy.

The concept is based on the hypothesis that given Model A as part of Model B, it is possible to find out about Model B in Model A. The alternative to this hypothesis could be a type of creation without macroeconomy being restricted to aggregate models.

For example, there are properties that can be discovered using the Model B cointegration procedure. It is based on a cohort of the theory of cointegrated systems: „Any linear non-zero combination of cointegration vectors is also a cointegration vector." In the simplest case, if there are two cointegrators in Model B, there is always a linear combination of these vectors that will remove one of the variables.

Analysis of the cointegration of a subset of variables (Model A), excluding that variable, will result in a cointegrator vector corresponding to that linear combination. Thus, despite being a property of Model B, cointegration analysis of the subsystem (Model A) identifies a cointegration vector. If this identification has an economic sense or is not an open issue, any solution must be argued in each case. Analysis based on such a system means the identification of the consumption function as a cointegrative relationship, the identification of the cointegrative relations used to establish prices and wages, the existence of a natural rate of unemployment and the relevance of the future-oriented terms of price and wage setting.

As Johansen (2002) pointed out, this is a difficult situation in the previous procedure: a general theory for the three stages will contain criteria and conditions that are formulated for the whole system. Sophisticated modeling on portions can be considered as a way of gradualism - seeking to establish the submodels that represent the partial structure; that is, partial models that are unidimensional to the extensions of the survey period, to changes elsewhere in the economy, and remain the same for extensions of the information set. Gradualism also implies a possible revision of a submodel. Revisions are sometimes triggered by the forecast failure. Several common reasons include revisions and data extensions that allow more accurate and improved model specifications. Dialogue between model makers and their users also results in revisions. Thus, experienced model users are usually able to highlight the implications of a single equation specification (or submodel) on the properties of the entire model.

Obviously, gradualism does not remove the in-depth testing of a submodel. On the contrary, the first two steps in the above procedure do not require that we know the whole model, and testing those conditions has a certain intuitive attraction since real life provides „new proof" through new data and „natural experiments" through changes such as changes in government or financial deregulation. For the three stages, we could basically consider the complete model as the ultimate extension of the set of information and thus the establishment of the partial structure or structure, which is a way to continue to find Johansen. Basically, we know the whole model is hard to achieve. We will reduce the activity to plotting the sectoral model graph with the simplified approximations of Model B, and will verify the relevant external assumptions of the partial model in the same frame. To the extent that the similar function of Simplified Model B is adequate or approximates the similar function of Full B Model, there is no problem. It is also possible to confirm the whole procedure since it is true that Model A can be tested and gradually improved with new information, which is a way of acquiring that knowledge that compares to modern Darwinism in natural sciences.

A practical reason for focusing on the submodels is as follows: modelers may have a good reason to study some branches of the economy with more attention than others. For a central bank targeting inflation, it is necessary to use the model of the inflationary process. It requires a careful modeling of institutional or conditional arrangements for pricing and wages, developments in financial markets and the real economy in order to answer a number of important questions: Is there a natural rate of unemployment that indicates unemployment and inflation? What is the importance of inflation probabilities and how can they be modeled? What is the role of money in the inflationary process?

We believe that in order to answer these questions - and to test competing hypotheses on supply-side economics, a detailed modeling based on information specific to the study economy is needed. Taking into account the simultaneity is to a large extent a matter of efficiency of estimation. If there is a correlation between this efficiency and the problem of regulating the economic mechanisms, macroeconomic modeling specialists should give priority to the last problem.

The history of macroeconomic modeling begins with the Dutch economist Jan Tinbergen who built and estimated the first macroeconomic models in the mid 1930s (Tinbergen 1937). Tinbergen has shown that someone can transform a system of equations into an econometric model of business cycle using economic theory to derive behavioral motivated dynamic equations and statistical methods to verify them. However, there seems to be a universal agreement according to which statistics is a discipline of economics and econometrics based on the contribution of Norwegian economist Trygve Haavelmo in his treaty „Approaching probability in econometrics". Haavelmo was inspired by some of the greatest time statisticians. As Morgan points out (1990), it was converted to the use of probability ideas by Jerzy Neyman, and was also influenced by Abraham Wald, which Haavelmo believed as a source of understanding of statistical theory.

It is important to emphasize that Haavelmo admitted and explained in the context of an economic model that the distribution with multiple variables of all variables observable for the whole studied period provides the general framework for statistical deduction (Hendry 1989). This applies to specifying / identifying, estimating and verifying the hypothesis:

„All are reduced to one and the same thing, namely, the study of the probability distribution properties with several variables of random variables in a stochastic system of equations".

Haavelmo's probabilistic revolution influenced econometrics. His thinking was immediately adopted by Jacob Marschak, a scientist of Russian origin who studied statistics with Slutsky, as a research agenda for the Cowles Commission from 1943-47, by reconsidering Tinbergen's business cycles. Marschak was joined by a group of statisticians, mathematicians and economists, including Haavelmo. Their work was to establish the standards of modern econometry and was found in the works of economics at Tintner (1952) and Klein (1953) and others. The Cowles Commission's work has laid the foundations for developing macroeconomic models and modeling that has become a broad „industry" in the US over the next three decades (Bodkin 1991 and Wallis 1994). These models were mainly designed for short and medium term forecasting, ie modeling for business cycle forecasting. The first model (Klein 1950) was created with the explicit purpose of implementing Haavelmo's ideas in Tinbergen's modeling for the US economy. Like the model of Tinbergen, this was a model in which Klein emphasized the modeling of simultaneous equations. Later models became extensive systems using more than 100 equations to describe the behavior of a modern industrial economy. In such models, less econometric specification was considered and simultaneity could not be treated satisfactorily. The purpose of these models' forecasts was that they were evaluated on the basis of their performance. When models failed to predict the effects on the industrial shocks of the 1973 and 1979 oil shocks, macroeconomic modeling has diminished its position, especially in the US.

In the 1980s, macroeconomic models took advantage of methodological and conceptual advances in econometrics based on a dynamic (chronological) series. Box and Jenkins (1970) created and popularized a purely statistical tool for modeling and forecasting one-dimensional chronological series. The second influx of statistical methodology into econometrics is rooted in the study of the non-static nature of economic data series. Clive Granger in his studies of statistics has shown in a series of valuable papers the importance of having an econometric equation balanced. A stationary variable can not be explained by a non-stationary variable and vice versa (Granger, 1990). In addition, the concept of cointegration (Granger 1981, Engle and Granger 1987, 1991), respectively a linear combination of two or more non-static variables can be stationary (fixed), has proven to be useful and important in macroeconomic modeling. In a general VAR model, the statistician Soren Johansen created (Johansen 1988, 1991, 1995b) the models used to test cointegration in a multidimensional framework, tracing the analytical mode of canonical correlation and Anderson's position regression (1951).

Greater attention has also been given to the role of evaluation in modern economics (Granger 1990, 1999). The so-called London School of Economics methodology highlights the importance of econometric testing and assessment models (Hendry 1993a, 1995a, Mizon 1995 and Ericsson 2005). Hendry (1989) claims that many aspects of Haavelmo's research have been ignored for a long time. For example, the function with multiple variables for observable variables has been recognized by the Cowles Commission as essential in solving statistical deduction problems, but ideas have not influenced empirical modeling strategies. In contrast, many developments in econometrics since 1980 correspond to this and other aspects of Haavelmo's research program. This also applies to the role of economic theory in econometrics, namely:

„Theoretical models are necessary tools in our attempts to understand and explain events in real life (Haavelmo 1944). But any explanation we prefer, one can not ignore that they are all our artificial inventions in a quest to understand real life, not hidden truths to be discovered. „ (Haavelmo 1944)

Having this starting point, we could expect facts or observations that correspond to any precise formulation derived from a theoretical model. Economic theories must therefore be expressed as probabilistic formulations and Haavelmo considered probability theory as indispensable in formalizing the notion of models as approximations of reality.

The Cowles Commission's research program has focused on Simultaneous Equation Models (SEMs) and has focused on identifying issues. In addressing these issues, economic theory plays an important role. A remarkable representative of this tradition, Lawrence Klein writes in a study on the interaction between statistics and economics in the context of macroeconomic modeling (Klein 1988) that the approach to modeling may be opposed to pure statistical analysis that is empirical and not closely related of economic theory as is the creation of models.

However, the creation of traditional macroeconomic models has also been criticized (Favero 2001). While the LSE methodology attributes the failure of those early macroeconomic models to the absence of model misinterpretation or specification, other critics such as Robert Lucas and Christopher Sims have claimed: „The reason is rather that it had a poor theoretical basis." Lucas's critique (Lucas 1976) claims that the failure of conditional models is caused by regime changes as a result of policy changes and changes in expectations. Criticism refers to SEMs, if probabilities are not modeled. On the other hand, Sims (1980) argued that SEMs include „incredible identification restrictions": „the restrictions required to claim the exogenity of certain variables would not be valid in an environment where agents occasionally optimize." Sims, on the other hand, supports the use of a low-order vector autoregression (autoregression) against the chronological economic series. This approach would have the advantage that it does not depend on an „arbitrary" separation between exogenous and endogenous variables and that it does not require „incredible identification restrictions". Instead, Sims introduced identification restrictions on the model error pattern, and this approach was criticized, being equally arbitrary. Subsequent developments have led to structural VAR models where cointegration defines long-term relationships between non-static variables and where exogenous variables are returned (Pesaran and Smith 1998), a study in which an early model of King (1991) is reanalyzed.

Since the Keynes-Tinbergen controversy (Morgan 1990 and Hendry and Morgan 1995), the role of modeling theory has been a major controversy in econometrics. At the end of the theory line - empiricism, we have theoretically deduced models that consider the theory and do not check it out. Important examples are the general equilibrium models, the actual synchronized business cycle models that have acquired a dominant position in the academic environment (Kydland and Prescott 1991). There is also a new series of macroeconomic models that imply optimization based on rational probabilities, leading to a multitude of Euler equations (Poloz 1994, Willman 2000, Hunt 2000 and Nilsson 2002 for models of central banks in Canada, Finland, New Zealand and Sweden). At the other extreme, there are data based on VAR models that were initially statistical tools that used economic theory to a minimum. Accordingly, in the case of structural VAR models, the theoretical constraints can be imposed as verifiable cointegrating relationships as a level or may be imposed in the model error pattern. The approach we support has much in common with the LSE methodology that we have referred to and focuses on the assessment as recommended by Granger (1999). It is a compromise between data-based models (purely statistical) and economic theory: on the one hand, we learn from the process of trying to seriously consider data, on the other hand we avoid making theoretical assumptions - necessary to make theories „Complete" - which would not be empirically relevant, that is, something that is not supported by the data.

It follows that the econometric methodology is lacking in consensus, so the approach to the macroeconomic modeling that we support is controversial. Heckman (1992) casts doubt on the success but not the importance of Haavelmo's probabilistic revolution. Keuzenkamp and Magnus (1995) also criticize the Keyman-Pearson paradigm for hypothetical verification and claim that econometrics has exerted little influence over economists' views over the last 50 years (Summers 1991). For skeptical interpretations of the LSE methodology, we mention Hansen (1996) and Faust and Whiteman (1995, 1997) to which Hendry replied.

Conclusion

From the study underlying this article, a series of theoretical and practical conclusions emerge. Firstly, the econometric methodology must be anchored in practical economic realities. Based on the aggregates underpinning the macroeconomic concept, statistical variables can be identified, which can be analyzed on a model basis. From the presented concepts it is concluded that only through correlational analysis can the parameters be obtained on the basis of which it is possible to forecast the economic evolution. Of course, these theoretical concepts can be mathematically formalized to obtain the parameters (parameters) on which to build the prospects of macroeconomic evolution. These theoretical conclusions lead to the idea that based on databases it becomes easy to build macroeconomic models.

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